Digital Money as a Unit of Account and Monetary Policy in Open Economies

Daisuke Ikeda

Bank of Japan

2 June 2021

ABFER 8th Annual Conference 2021
International Macroeconomics, Money & Banking (Joint with CEBRA)

Rise of digital money

- Technological innovations and digitalization
- Alipay, Libra, M-Pesa, Paxos, Swish...
- Stablecoins: seek to stabilize the price of the "coin"
- Many challenges and risks as well as benefits
  (G7 Working Group on Stablecoins, 2019)
- This paper: monetary policy

International dimensions and digital dollarization

- Importance of international dimensions
  - "*If Swiss franc stable coins were to proliferate in Switzerland, this would have no immediate impact on the effectiveness of our monetary policy.*" (Jordan, 2019)
  - "*However, if stable coins pegged to foreign currencies were to establish themselves in Switzerland, the effectiveness of our monetary policy could be impaired.*" (Ibid)
- Innovations may enable pricing in any currency in any country
- Digital dollarization (Brunnermeier et al., 2019) may ensue

Three questions for monetary policy

1. How does digital dollarization affect monetary policy transmission?
2. Under what conditions does digital dollarization deepen?
3. Can monetary policy block or facilitate digital dollarization?

Approach: new open economy macro

- Focus on a unit of account as a role of money (Woodford, 2003)
- A cash-less open economy model with nominal rigidities
- Two countries: Home (H) and Foreign (F)
- Digital money allows pricing in units of currency F in country H
- Using digital money: frictionless and costless
- Study analytically and numerically

Answers to the three questions

1. Monetary policy becomes less effective as dollarization deepens
2. Dollarization is more likely to occur in a country that is:
   - Smaller in size
   - More open to trade (less home bias)

   and has:
   - A greater tradable sector (smaller non-tradable sector)
   - Stronger input-output linkages (larger intermediate input)
3. Monetary policies, both H and F, can affect dollarization

Related literature

- Digital money as a medium of exchange
  Fernández-Villaverde and Sanches (2019); Schilling and Uhlig (2019); Benigno (2019); Benigno et al. (2019)

- New open economy macro
  Obstfeld and Rogoff (1995); Corsetti and Pesenti (2009)

- Currency substitution
  Felices and Tuesta (2007); Batini et al. (2010); Kumamoto and Kumamoto (2014)

- Invoice currency choices
  Devereux et al. (2004); Engel (2006); Castillo (2006); Gopinath et al. (2010); Mukhin (2018).

- Dominant currency pricing
  Goldberg and Tille (2016); Gopinath et al. (2020)

Outline

Analytical model: overview

Corsetti and Pesenti (2009), extended to incorporate:

- country size
- trade openness (home bias)
- non-tradable sector
- tradable goods as intermediate input
- kinked demand curve (Kimball, 1995) for tradable goods
- nominal wage rigidity

Key features for analytical tractability

- Prices and wages are set one period in advance
- Nominal aggregate as a monetary policy instrument
- i.i.d. shocks

Households

- Preferences for household $j \in (0, n)$

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\log C_t(j) - \frac{\psi}{1+\frac{1}{\nu}} L_t(j)^{1+\frac{1}{\nu}} \right)$$

- Flow budget constraint

$$P_t C_t(j) + \sum_{s_{t+1}} Q(s_{t+1}|s_t) B_t(s_{t+1}; j) = W_t(j) L_t(j) + B_{t-1}(s_t; j) + \Theta_t(j)$$

- Complete asset market

- Symetric for Foreign household $j \in (n, 1)$

Consumption bundle

- Consumption bundle $C_t(j)$

$$C_t(j) = \left(\frac{C_{Nt}(j)}{\gamma_n}\right)^{\gamma_n} \left(\frac{C_{Tt}(j)}{1-\gamma_n}\right)^{1-\gamma_n}$$

- Non-tradable consumption bundle $C_{Nt}(j)$

$$C_{Nt}(j) = \left[\int_0^1 C_{Nt}(j,i)^{\frac{\theta_n - 1}{\theta_n}} di\right]^{\frac{\theta_n}{\theta_n - 1}}$$

- Tradable consumption bundle $C_{Tt}(j)$

$$\frac{1-\gamma_\tau}{n}\int_0^n G\left(\frac{nC_{Ht}(j,i)}{(1-\gamma_\tau)C_{Tt}(j)}\right)di + \frac{\gamma_\tau}{1-n}\int_0^{1-n} G\left(\frac{(1-n)C_{Ft}(j,i)}{\gamma_\tau C_{Tt}(j)}\right)di = 1$$

$\gamma_\tau = (1-n)\bar{\gamma}$ and $\bar{\gamma} \in [0,1]$ is the degree of trade openness

Kimball aggregator $G' > 0, G'' < 0, -G'' \in (0,1), G(1) = G'(1) = 1$

Firms

- Non-tradable good i: production and profits

$$Y_{Nt}(i) = A_t \left(\frac{L_{Nt}(i)}{1-\phi_n} \right)^{1-\phi_n} \left(\frac{X_{Nt}(i)}{\phi_n} \right)^{\phi_n}$$

$$\Pi_{Nt}(i) = (P_{Nt}(i) - MC_{Nt}) \left(\frac{P_{Nt}(i)}{P_{Nt}} \right)^{-\theta_n} C_{Nt}$$

- Tradable good i: production and profits

$$Y_{Tt}(i) = A_t \left(\frac{L_{Tt}(i)}{1-\phi_\tau} \right)^{1-\phi_\tau} \left(\frac{X_{Tt}(i)}{\phi_\tau} \right)^{\phi_\tau}$$

$$\Pi_{Tt}(i) = (P_{Ht}(i) - MC_{Tt}) g \left(\frac{P_{Ht}(i)}{\mathcal{P}_{Tt}} \right) \frac{1-\gamma_\tau}{n} (C_{Tt} + X_{Tt} + X_{Nt}) + \ldots$$

where $g = G'$

Price setting: one-period in advance

- Flexible price benchmark (log-linearized): natural price

$$\tilde{p}_{Ht}(i) = (1-\alpha)mc_{Tt} + \alpha p_{Tt}$$

- Marginal costs

$$mc_{Tt} = -a_t + (1-\phi_\tau)w_t + \phi_\tau p_{Tt}$$

- Nominal rigidities: one-period in advance

$$p_{Ht}(i) = \begin{cases} E_{t-1}\left(\tilde{p}_{Ht}(i)\right) & \text{if currency } H \text{ is chosen} \\ E_{t-1}(\tilde{p}_{Ht}(i) - e_t) + e_t & \text{if currency } F \text{ is chosen} \end{cases}$$

$e_t = \log(\mathcal{E}_t)$ is the log exchange rate

Competitive equilibrium

- Nominal aggregate as a monetary policy instrument

$$m_t = p_t + c_t$$

with m_t i.i.d. (monetary policy shock)

- Exchange rate

$$e_t = m_t - m_t^* + z_{et}$$

with z_{et} i.i.d. (exchange rate shock)

- Market clearing: labor, non-tradables, and tradables

Real effects of monetary policy

- From monetary policy

$$c_t = m_t - p_t$$

- λ_h: fraction of H-currency pricing $h \in H, F, N$

- Price level

$$p_t = \{\gamma_n(1-\lambda_N) + (1-\gamma_n)\left[(1-\gamma_\tau)(1-\lambda_H) + \gamma_\tau(1-\lambda_F)\right]\}e_t$$

- Monetary policy impact on exchange rate

$$\frac{\partial e_t}{\partial m_t} = 1$$

Effects of dollarization on monetary policy

Proposition 1

The impact of Home monetary policy on Home consumption decreases and that of Foreign monetary policy increases as:

1. *More firms use currency F as an invoice currency*
2. *The size of country H becomes smaller*
3. *The country H becomes more open to trade*
4. *The tradable sector becomes greater*

- Dollarization deepening $\rightarrow$ higher exchange rate path-through
- Changes in nominal aggregate, accompanied by sizable inflation
- Consumption $=$ nominal aggregate $-$ price level

Invoice currency choices

- Tradable good firm i's currency choice problem:

$$\max\left\{ E_{t-1} Q_{t-1,t} \Pi^{H}_{Tt}(i),\ E_{t-1} Q_{t-1,t} \Pi^{F}_{Tt}(i) \right\}$$

  Π^{h}_{Tt}: the firm's profits with currency h as an invoice currency

- Approximated problem (up to the second-order):

$$\min\left\{ V(\tilde{p}_{Tt}(i)),\ V(\tilde{p}_{Tt}(i) - e_t) \right\}$$

- The firm chooses currency F iff

$$\frac{\partial \tilde{p}_{Tt}(i)}{\partial e_t} > 1/2$$

Dominant currency paradigm and possible dollarization

- Country F as a country with a dominant currency
- Import and export prices set in units of currency F
- Which currency, H or F, is used as an invoice currency in country H?
  - Tradable goods firms' prices
  - Non-tradable goods firms' prices
  - Wages

What country is vulnerable to dollarization?

- No price setting complementarities ($\alpha = 0$ and $\phi_n = \phi_\tau = 0$)
  $\rightarrow \tilde{p}_{Tt}(i) = w_t - a_t$, no dollarization
- Assume $\alpha > 0$ or $\phi_n, \phi_\tau > 0$

Proposition 2

Assume linear disutility of labor. Home firms are more likely to set prices in units of currency F as

1. *More tradable goods prices are set in units of currency F*
2. *Country H becomes smaller*
3. *Country H becomes more open to trade*
4. *More wages are set in units of currency F*
5. *Intermediate input shares (ϕ_n and ϕ_τ) become higher*
6. *Degree of the kink in the demand curve (α) increases*

Outline

Extended model

The analytical model, extended to incorporate:

- Staggered prices and wages (Calvo, 1983; Erceg et al., 2000)
- Persistent shocks, following AR(1) processes
  - Productivity, monetary policy, and exhange rate shocks
- Monetary policy rules for the short-term interest rates
- Labor supply elasticity $< \infty$

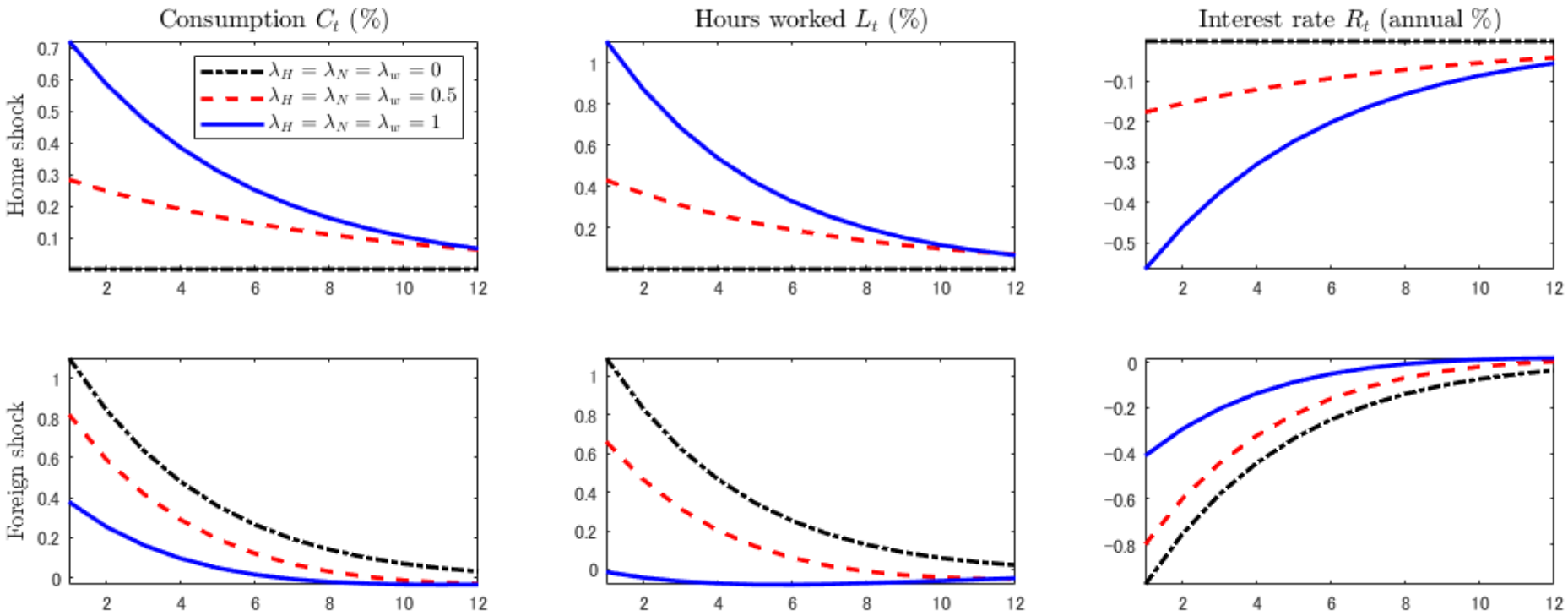
Parameters

Table: Parameters

Parameter	Value	Parameter description	Value source
		Key parameters (baseline values)	
λ_N, λ_H, λ_w	1	Currency choice	Dominant currency pricing
n	0.01	Size of the Home country	Small country
γ_n	0.44	Share of non-tradable goods	Lombardo and Ravenna (2012)
ϕ_n, ϕ_τ	0.33	Share of intermediate input	Lombardo and Ravenna (2012)
$\bar{\gamma}$	0.433	Trade openness	Trade-to-output ratio of 0.5
α	0.6	Pricing complementarities	Gopinath and Itskhoki (2011)

Effects of dollarization on monetary policy

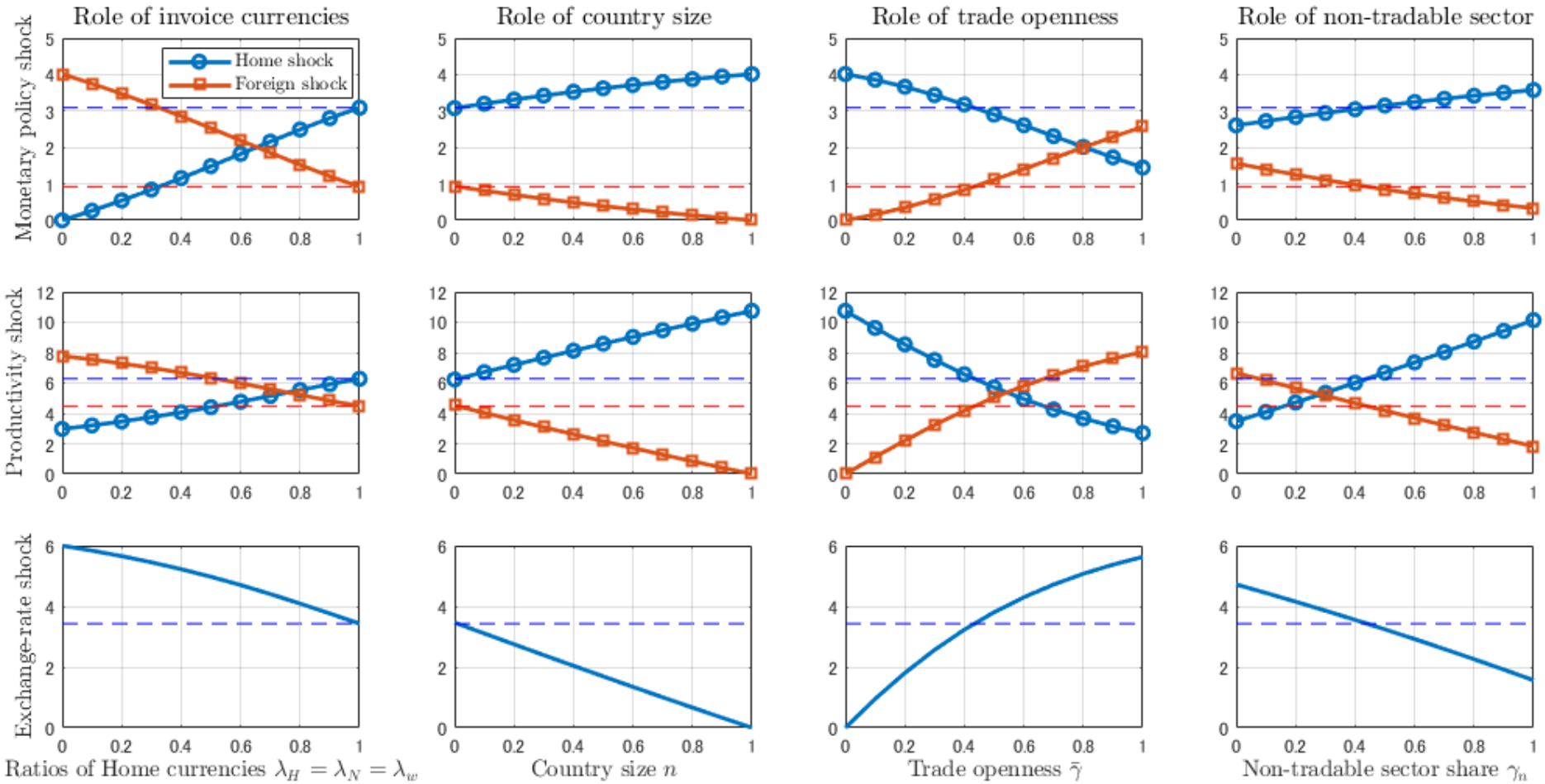
Figure: Impulse responses to monetary policy shocks



- Blue line: no dollarization
- Red dashed line: partial dollarization
- Black dot dashed line: full dollarization

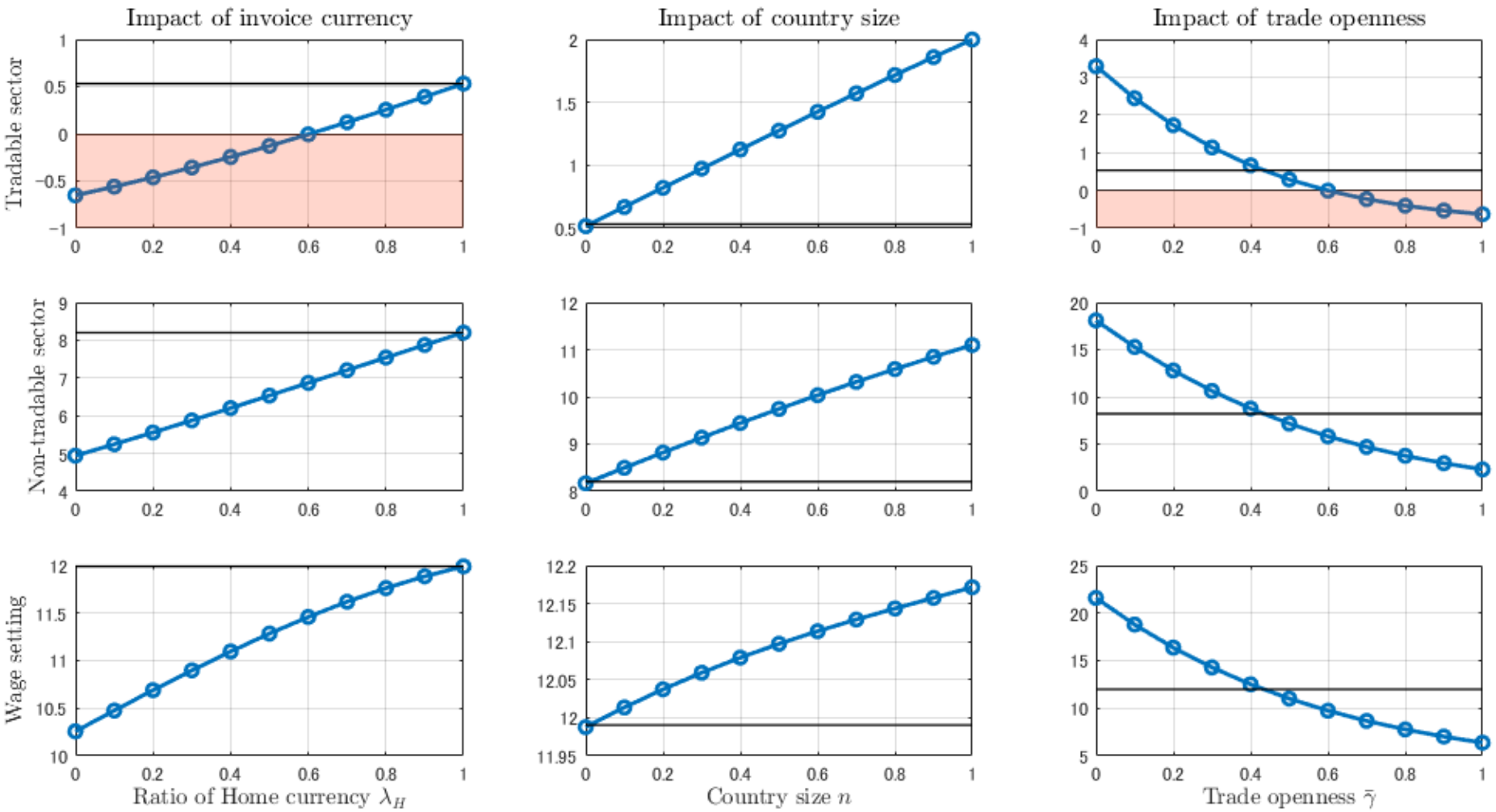
Effects of dollarization on shock transmission

Figure: Cumulative effects on the Home consumption (%, over 8 quarters)



Can dollarization occur?

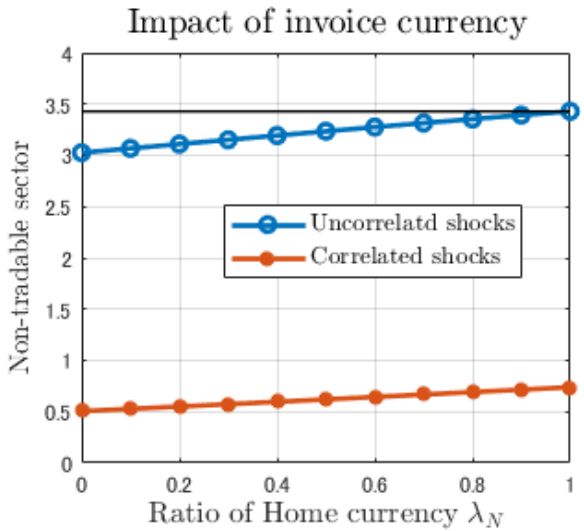
Figure: Net benefits of choosing currency H

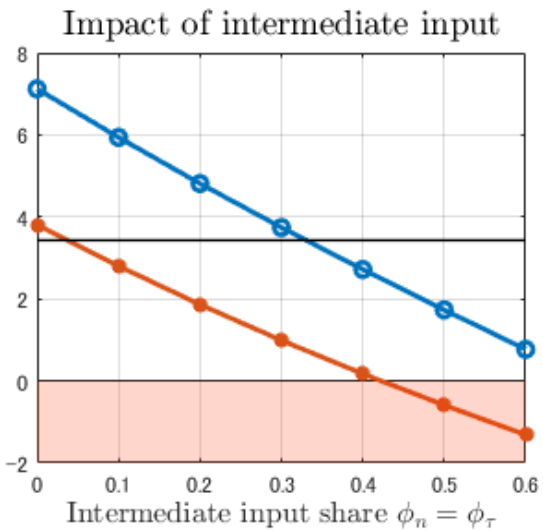


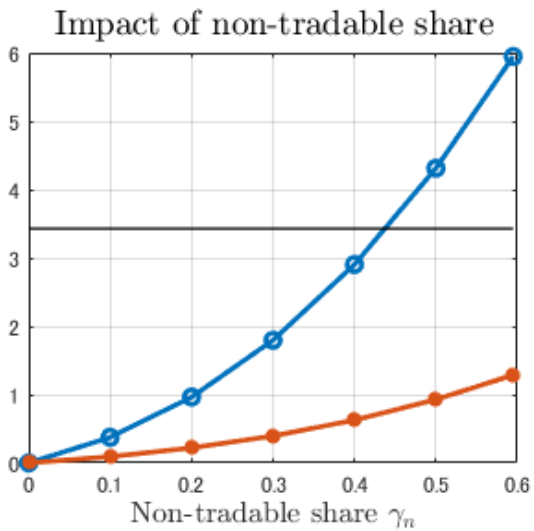
Can dollarization occur in the non-tradable sector as well?

- Assume high trade openness $\bar{\gamma} = 0.7$
- Dollarization in the tradable sector $\lambda_H = 0$
- H productivity shock is partly driven by F productivity shock

Figure: Net benefits of choosing currency H when $\lambda_H = 0$ and $\bar{\gamma} = 0.7$

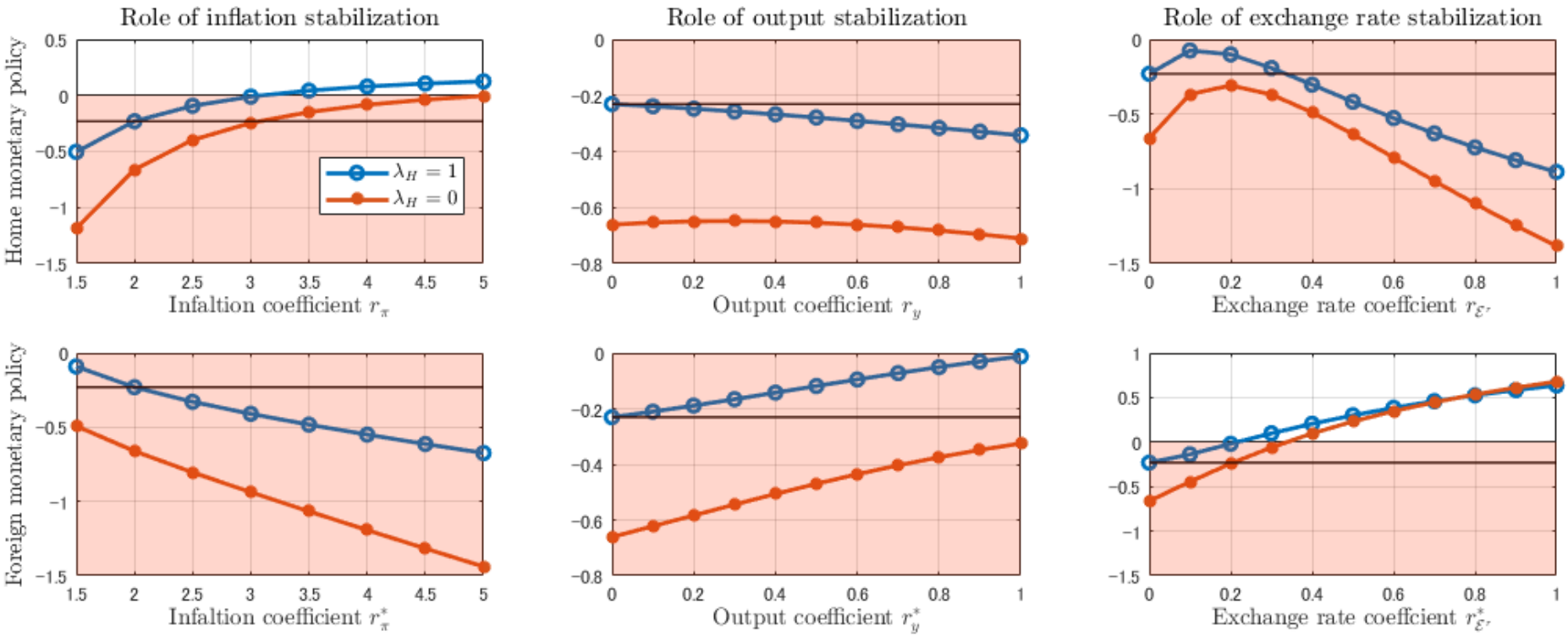






Role of monetary policy for dollarization

Figure: Net benefits of choosing currency H in the tradable sector ($\bar{\gamma} = 0.7$)



$$\log(R_t/R) = \rho_r \log(R_{t-1}/R) + (1-\rho_r)\left[r_\pi \log(\pi_t) + r_y \log(Y_t/Y_{t-1}) + r_{\mathcal{E}^r} \log(\mathcal{E}^r_t/\mathcal{E}^r)\right]$$

Outline

Conclusion: three questions and answers

1. Impact of digital dollarization on monetary policy?
   - Monetary policy's ability to stabilize the real economy weakens
2. Under what conditions can dollarization deepen?
   - Country small in size, open to trade, and stronger linkages with F
3. Can monetary policy discourage dollarization?
   - Yes, especially by focusing on stabilizing inflation

Conclusion: three caveats

1. Exclusively focused on a unit of account as a role of money
2. Assumed friction-less cost-less digital money
   - Stablecoins: demand for safe assets
3. Considered currency F or H
   - Synthetic currency (Carney, 2019) e.g. 50% H and 50% F

Thank you